Atomic Fountains for the USNO Master Clock

C. Ekstrom, S. Peil, T. Swanson, and S. Crane

U. S. Naval Observatory
Time Service Department
Washington, DC

We will present details of the construction and initial results from our first two rubidium fountains built as operational clocks for our timing ensemble. This will include details and tradeoffs in the design where we had to balance performance and in some cases elegance against our ability to produce several identical devices. This has resulted in a very modular and general design of electronics components that should allow quick replacement of subsystems and uniform upgrades or design changes across all of the devices.

The laser systems are housed on two rack-mounted optical tables. The first houses two ECDL's and one tapered amplifier. These are coupled into two polarization maintaining optical fibers that run to the second table. The second table includes the frequency shifters, optical shutters, splitters, and spectroscopy for generating and locking the laser frequencies. The light is transported to the physics package on polarization maintaining fibers.

We will also present several results from our engineering prototype that cover short and long term stability measurements. Short-term stabilities are typically 1.5e-13 at one second, with long-term stabilities of 3e-16 measured against our local master clocks. We will also present highlights of our systematic studies, including investigations into our ability to operate the device with a magneto-optical trap.

Finally, we will describe the new rubidium fountains' role in the USNO Master Clock, including a new facility designed to house and measure a large portion of the USNO timing ensemble.